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Tillage Operations and Tractor Model Influence in Contributring Carbon IV Oxide (Co_2) Gas Emmissions into the Environment

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ABSTRACT
Agricultural production operations are usually initiated by land preparations. Farmland preparation (tillage operations) requires the use of tractor that contributes to greenhouse gas emissions to the environment. In a mechanized farming the three major tillage operations includes Plough, Harrow and Ridge. Carbon IV oxide (CO_2) gas is one of the numerous gases emitted into the atmosphere during farmland operations carried out by the use of tractors. Most tractors are powered by fossil fuel which increases global warming effects. In order to achieve one of the sustainable goals which is to reduce dangerous gases from the environment, Carbon IV oxide (CO_2) gas needs to be quantified. A field operation study was conducted in the South-western state of Nigeria to determine the amount of CO_2 gas released into the environment during the three major tillage operations (Plough, Harrow and Ridge preparations) when comparing the use of two (2) different tractor models with two different ages (old and new). It was observed that tractor T_2 (McFergusson, old) released highest concentration values of CO_2 gas for all tillage operations especially during first plough operation. The highest value of 3050 was recorded for first ploughing operation and T_3 (NewHolland, new) tractor released the lowest concentration values of CO_2 gas for all tillage operations.. For the four tillage operations T_2 (McFergusson, old) emits the highest amount of CO_2 followed by T_4 (NewHolland, old); T_3 (NewHolland, new) have the lowest concentration values of CO_2 gas during ridging operation. T_1 (McFergusson, new) and T_3 (NewHolland, new) tractor have low emission of CO_2 to the environment while T_2 (McFergusson, old) and T_4 (NewHolland, old) have high emission of CO_2 to the environment during the tillage operation. These shows that age of a tractor have effect on the emission of CO_2 to the environment and T_2 (McFergusson, old) emits the highest CO_2 during the first plough while T_3 (NewHolland, New) emits the lowest during ridging. Ploughing operation produce highest concentration of CO_2 while ridging operation produces the lowest concentration of CO_2

KEYWORDS: CO_2 , Environment, Emission, Greenhouse gas, Tillage operation, Tractor model,

I. INTRODUCTION

One of the few important means of increasing farm production per hectare is to mechanize it. Agricultural system all over the world has undergone changes in terms of cropping system, type of power sources used and application of inputs to achieve high level of production. In certain region, the level of mechanization has gone far ahead of the average level in the country. Human and animal power sources are no longer the predominant sources on farms. Since Agricultural mechanization is the application of mechanical technology and increased power to agriculture, largely as a means to enhance the productivity of human labour and often to achieve results well beyond the capacity of human labour with optimum yield and at minimal cost (Mohammad et al, 2018). Production of crops for food requires a number of operations like seed bed preparation, seeding, fertilizing, spraying, dusting, irrigation, harvesting and threshing. The first operation in production of crop is tillage. Sahay (2010) defined tillage as the mechanical manipulation of soil to provide favourable condition for crop production. Tillage operation is divided into primary tillage and Secondary tillage. The primary tillage constitutes the initial major soil working operation. It is normally designed to reduce soil strength, cover plant materials, and rearrangement of the soil aggregates. The secondary tillage is lighter and

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finer operations, performed on the soil after primary tillage operations to create proper soil tilt for seeding and planting. The processes involved in the primary and secondary tillage include first plough, secondary plough, harrowing and ridging.

To mechanical manipulate the soil favourable for crop requires higher amount of labour and energy (Amanullah, 2020). Increasing in the use of agricultural equipment with performance of tractor stock influence the pollution of the environment by exhaust gases. Poisonous exhaust substances, oil products and their vapour are disposed to the environment through engine breather and various wane products. The bigger concentration of the equipment used, the bigger the noise level. These environmentally-unfriendly impact factors break the ecological balance that cause the decrease soil productivity and have a negative influence on human health (Šimatonis and Tiškevičius 1994).

If fuel in the engine would combust totally, the exhaust gases should consist of various gases like nitrogen oxides NOx, carbon dioxide CO_2, vapour H_2O and nitrogen N_2. But in reality fuel doesn't combust completely, therefore, exhaust gases can contain carbon monoxide CO, pure carbons (soot) C, hydrocarbons HnCm, aldehydes R·CHO, nitrogen oxides NOx. Combustion of sulphurous fuel creates sulphur dioxide SO_2 and SO_3, sulphur hydrogen H_2S in exhaust gases (Šimatonis and Tiškevičius 1994; Labeckas and Slavinskas 2003). From ecological point of view CO_2 is a dangerous gas because it creates a kind of a film which inhibits the warming of the Earth surface. Because of thermal effect the Earth temperature, during the last century, has increased on average by 0,3–0,7 °C (Šimatonis and Tiškevičius 1994; Impact on the soil compaction is less when tractors are aggregated with correct agricultural equipment. Low tractor load requires more passes on the same field hence leads to bigger fuel consumption for the same plot of a cultivated area. High fuel consumption leads to a higher pollution of the environment. Too big tractor load could lead to wheel slippage which damages the soil structure and increases fuel consumption for the same plot area. Besides, fuel consumption and noxiousness depends on engine working conditions (Kraujalis 2002; Janulevičius and Juostas 2007;).

II. MATERIALS AND METHODS

The study was conducted in Lagos State University of Science and Technology, Ikorodu, West of Nigeria under the western vegetation in sandy-loamy soil. The study area falls within the geographical location $16^0$37'0" North, $3^0$37'0" east of the western part of Nigeria.

The equipment and materials used for the study includes: measuring tape, New Holland tractor (old and new), Massey Fergusson tractor (old and new), 14.4 hectares of land, 2 Hand held gas collector (multiRAE Pro), Disc plough, disc harrow and Ridger. Tractor(T_1= McFegusson (new), T_2= McFergusson (old), T_3= NewHolland (new), T_4= NewHolland (old)) below the age of ten years are referred to as **NEW** and above ten years are referred to as **OLD.**

The major tillage operations were conducted first plough; second plough; harrowing and ridging at 13days, 5days,and 3 days time intervals respectively . During the first plough, the four tractors were allowed to run at various hand throttle speed of 15km/hr. 20km/hr and 24km/hr.. After 13 days, the second plough was carried out using the four tractors at the operating hand throttle speed of 15km/hr, 20km/hr and 24km/hr. After the fifth day, the harrowing operation was carried out using the four tractors at various operating hand throttle speed of 15km/hr, 20km/hr and 24km/hr. Finally, after the third day, the ridging operation was carried out with the four tractors at the operation hand throttle speed of 15km/hr, 20km/hr and 24km/hr.

III. RESULTS AND DISCUSSION

Table 1: Carbon (IV) oxide, (CO_2) emission levels (ppm) during tillage operations.

Speed	Tractor	1st Ploughing Operation	2nd Ploughing Operation	Harrowing	Ridging
15km/ hr	T1	3006.67 ± 114.49^{h}	2315.13 ± 88.16^{h}	$2104.67 \pm 80.14h$	1894.20 ± 72.13^{h}
	T2	5466.67 ± 208.17^{j}	4209.33 ± 160.29^{j}	3826.67 ± 145.72^{j}	3444.00 ± 131.14^{j}
	T3	557.25 ± 7.29^{a}	567.28 ± 5.60^{a}	552.08 ± 5.09^{a}	556.87 ± 4.58^{a}
	T4	595.00 ± 13.23^{b}	576.15 ± 10.19^{b}	576.50 ± 9.26^{b}	558.85 ± 8.33^{b}
20 km/ hr	T1	898.33 ± 42.01^{c}	691.72 ± 32.34^{c}	628.83 ± 29.41^{c}	565.95 ± 26.46^{c}
	T2	1633.33 ± 76.38^{e}	1257.67 ± 58.81^{e}	1143.33 ± 53.46^{e}	1029.00 ± 48.12^{e}
	T3	1787.50 ± 72.76^{f}	1376.38 ± 56.02^{f}	1251.25 ± 50.93^{f}	1126.13 ± 45.84^{f}

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	T4	3250.00 ± 132.29^{i}	2502.50 ± 101.86^{i}	2275.00 ± 92.60i	2047.50 ± 83.34^{i}
	T1	1127.50 ± 27.50^{d}	868.18 ± 21.18^{d}	789.25 ± 19.25^{d}	710.33 ± 17.33^{c}
	T2	2050.00 ± 50.00^{g}	1578.50 ± 38.50^{g}	1435.00 ± 35.00^{g}	1291.50 ± 31.50^{g}
24km/ hr	T3	1173.33 ± 42.01^{d}	903.47 ± 32.34^{d}	821.33 ± 29.41^{d}	739.20 ± 26.46^{d}
	T4	2133.33 ± 76.38^{g}	1642.67 ± 58.81^{g}	1493.33 ± 53.46^{g}	1344.00 ± 48.12^{g}

Superscripts with the same letters down the column are not significantly ($p < 0.05$) different (DMRT).
T_1= McFegusson (new), T_2= McFergusson (old), T_3= NewHolland (new), T_4= NewHolland (old)

Table 2: Effect of tillage operation and tractor model on carbon (IV) oxide gas emission levels in (ppm)

	T 1	T 2	T 3	T 4
1st plough	1677.5	3050	1172.693	1992.777
2ndplough	1291.677	2348.5	949.0433	1573.773
Harrowing	1174.25	2135	874.8867	1448.277
Ridging	1056.827	1921.5	807.4	1316.783

T_1= McFegusson (new), T_2= McFergusson (old), T_3= NewHolland (new), T_4= NewHolland (old)

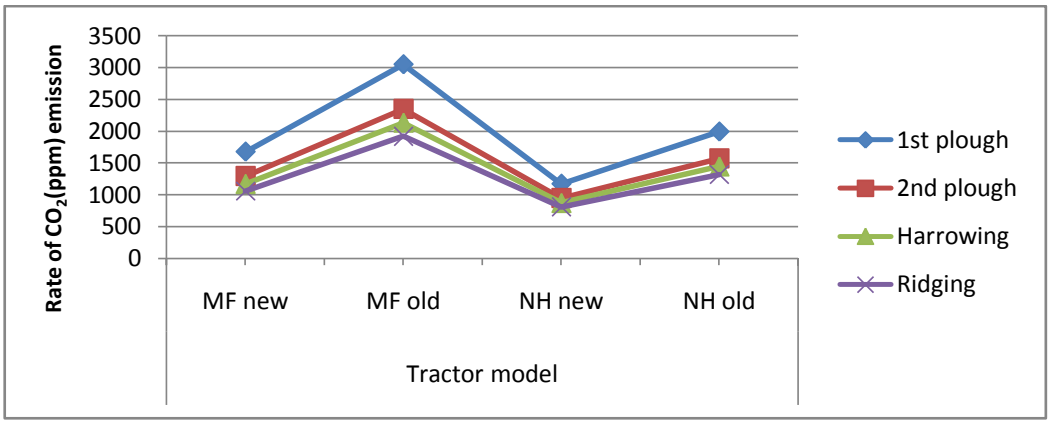

Fig1: Effect of tillage operation and tractor model on carbon (IV) oxide gas emission

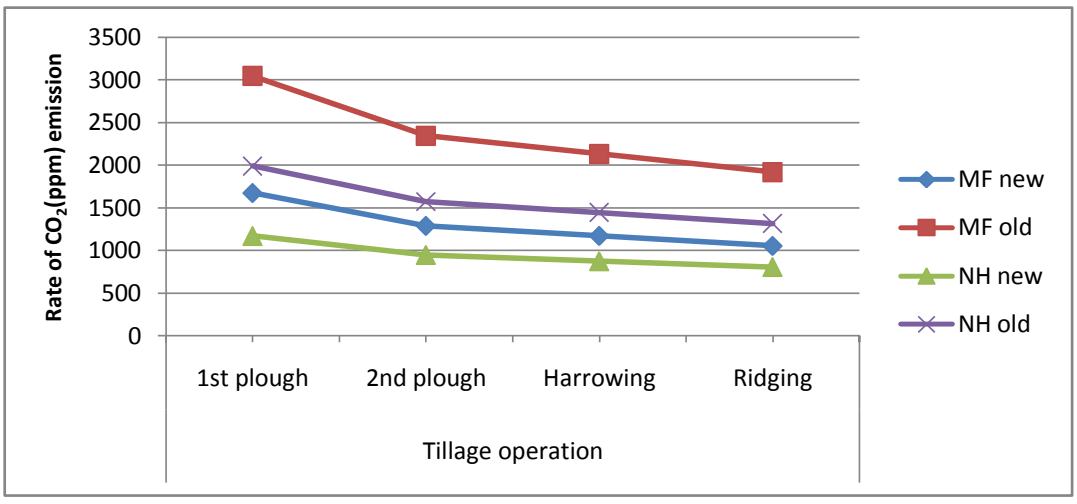

Figure 2: Effect of tillage operation and tractor model on carbon (iv) oxide gas emission

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Effect of tillage operation and tractor model on carbon (iv) oxide (CO_2) gas emission.

The results from table 1 show that the amount of CO_2 generated have no significant differences between the following combination of tillage operation types and models of tractor: first plough with T_1 (McFergusson, new) and second plough with T_4 (NewHolland, old); first plough with T_3 (NewHolland, new), second plough with T_1 (McFergusson, new), harrowing with T_1 (McFergusson, new) and ridging with T_4 (NewHolland, old); first plough with T_3 (NewHolland, new), harrowing with T_1 (McFergusson, new) and ridging with T_1 (McFergusson, new); first plough with T_4 (NewHolland, old) and harrowing with T_2 (McFergusson, old); first plough with T_4 (NewHolland, old) and ridging with T_2 (McFergusson, old); second plough with T_3 (NewHolland, new) and ridging with T_1 (McFergusson, new); second plough with T_3 (NewHolland, new), harrowing with T_3 (NewHolland, new) and ridging with T_3 (NewHolland, new); harrowing with T_4 (NewHolland, old) and ridging with T_4 (NewHolland, old). However, first plough with T_2 (McFergusson, old) and second.

It was also observed from table 2 that tractor T_2 (McFergusson, old) had higher values for all tillage operations and T_3 (NewHolland, new) tractor had lower values for all tillage operations. No significant difference was noticed for harrowing operation and ridging operation while using T_3 (NewHolland, new) tractor with ridging operation having the lowest recorded value of 807.3. The highest value of 3050 was recorded for first ploughing operation using T_2 (McFergusson, old).

It can be observed from Figure 1 and 2, that T_2 (McFergusson, old) emits the highest concentration of CO_2 gas during the first plough while T_3 (NewHolland, New) emits the lowest concentration of CO_2 during tillage operation especially during ridging. For the four tillage operations T_2 (McFergusson, old) emits the highest amount of CO_2 followed by T_4 (NewHolland, old), T_1 (McFergusson, new) and T_3 (NewHolland, new) which is the lowest.

The highest concentration of CO_2 emission into the environment during tillage operations were in order of first plough, second plough, harrow, and ridging that produce the lowest concentration.

IV. CONCLUSION

No significant difference was noticed for harrowing operation and ridging operation while using T_3 (NewHolland, new) tractor with ridging operation having the lowest recorded value of 807.3. T_2 (McFergusson, old) emits the highest CO_2 during the first plough while T_4 (NewHolland, old) emits the lowest during ridging. Ploughing operation produce highest concentration of CO_2 while ridging operation produces the lowest concentration of CO_2

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